Fundamental of Materials Science Homework 4

Read Me:

Work on the following problems. Make sure you follow the suggested homework template and comply with all home work requirements as specified so far in the course website.

All equations are to be typed with equation editor in MS Word. If you are using Microsoft Office 2007, please use the “Insert-Object-Microsoft Equations 3.0” function for equation input. If you are using a version above 2007, you can also use the “Insert Equation” function that comes with software.

This homework assignment provides a set of exercises on the atomic structure of elemental entities or compounds. By the time you start your homework 4, I assume you have already read through the relevant chapter contents and understood the core concepts, such as protons, neutrons, electrons, isotopes, atomic mass unit (amu), Avogadro’s number, atomic number, etc. Conversion between atomic quantities to measurable mass quantities such as in grams is a fundamental skill you must possess. You also need to understand the principles that brought in the electronic configuration of atoms, that is, a wave mechanical model to find the solution of wave functions to arrive at different quantum numbers potentially as a notation for labeling electron orbitals.

Always remember: read the textbook and lecture note before working on the problems.

Homework Problems:

1. Calculate the number of atoms contained in a cylinder 1 μm in diameter 1 μm deep of (a) lead and (b) copper.
2. One mole of solid MgO occupies a cube 22.37 mm on a side. Calculate the density of MgO (in g/cm3).
3. Using the density of MgO calculated in Problem 2, calculate the mass of an MgO refractory (temperature-resistant) brick with dimensions 50 mm × 100 mm × 150 mm.
4. Calculate the dimensions of (a) a cube containing 1 mol of magnesium and (b) a cube containing 1 mol of lead.
5. Silicon has three naturally-occurring isotopes: 92.23% of 28Si, with an atomic weight of 27.9769 amu, 4.68% of 29Si, with an atomic weight of 28.9765 amu, 3.09% of 30Si, with an atomic weight of 29.9738 amu. On the basis of these data, calculate the average atomic weight of Si in amu.
6. Allowed values for quantum numbers of electrons are as follows:

*n* = 1, 2, 3 …

*l* = 0, 1, 2, 3… n-1

*ml* = 0, ±1, ±2, ±3 …±*l*

*ms* =

The relationship between n and the shell designation are noted in Table 2.1. Relative to the subshells,

*l*=0 corresponds to an *s* subshell

*l*=1 corresponds to a *p* subshell

*l*=2 corresponds to a *d* subshell

*l*=3 corresponds to an *f* subshell

For the K shell, the four quantum numbers for each of the two electrons in the 1s state, in the order of *nlmlms*, are 100 and 100

Write the four quantum numbers for all the electron in the *L* and *M* shells, and note which correspond to the *s*, *p* and *d* subshells.

1. Give the electron configurations for the subshells of the following ions: , , , , , and.

\*Materials Data can be found from the Elemental Data and Constants file uploaded on the course website.